



Written Statement
By
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On the Importance of Continuity in the U.S. Polar Orbiting
Meteorological Satellite Program
Before
The Subcommittee on Environment, Technology, and Standards
Committee on Science
U.S. House of Representatives

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Chairman Ehlers, Mr. Udall, distinguished members of the Committee: I am pleased to have the opportunity to testify before your Subcommittee on this very important topic. I speak to you today from the vantage point of long-time involvement with the polar orbiting meteorological satellite program, as a user of atmospheric observations from polar orbiting satellites. During my nearly 40-year career with the National Weather Service, much of my interest and energy was devoted to developing and improving the performance of computer-based weather forecasting models, and in particular to enhancing the effectiveness with which satellite data are used in those models. From 1990 until 1998, I was the Director of the National Centers for Environmental Prediction (NCEP), that component of NOAA's National Weather Service responsible for the operations of the computer-based models that serve as the basis for virtually all weather forecasts in the United States. Since 1999, I have served as the Executive Director of the American Meteorological Society, the scientific and professional association of more than 11,000 scientists and practitioners in the atmospheric and related oceanic and hydrologic sciences and services.

I was asked to address five questions, having mostly to do with the prospect of a potential interruption in the availability of atmospheric observations from polar orbiting satellites as we transition from POES to NPOESS, and indeed the polar satellite program is the main focus of this statement. Nevertheless, it may be useful to briefly discuss a previous circumstance in which the meteorological enterprise was in the precarious position of possibly losing data from NOAA's geostationary satellite program.

The advent of geostationary satellites providing real-time images of global weather patterns has profoundly changed society's notions about global weather. Those images on local, national, and international television of immense cloud systems that span whole continents and sometimes cross hemispheres provide clear visual evidence of the connectivity of today's weather along the west coast with next weekend's weather in the mid-Atlantic region.

In the mid-1980s, a series of unfortunate policy and budget decisions and a satellite launch failure left the U.S. with a single geostationary satellite for almost six years, from January 1989 through January 1995. I was Deputy Director of the National Weather Service during a portion of that time. We dealt with that situation by shifting the one active U.S. geostationary satellite back and forth seasonally: during hurricane season, it covered the Atlantic, Gulf of Mexico and Caribbean, and during the winter it was

positioned over the eastern Pacific to give coverage to the west coast for winter storms. We also “borrowed” an older, less capable geostationary satellite from the Europeans to help with coverage.

We made it through that difficult period without disastrous consequences. But if we had lost the single functioning geostationary satellite during that period, the National Weather Service’s ability to warn citizens of tropical storms and large complexes of severe thunderstorms would have been very seriously compromised. The extraordinary importance of the satellite imagery to communicate serious weather problems to the public through television would have been lost.

Geostationary satellites are most valuable for real time monitoring of weather hazards such as hurricanes and severe thunderstorm systems. By contrast, polar orbiting satellites bearing instruments that sense quantities related to atmospheric temperature structure are most valuable as input to computer based forecast models; indeed, when these data became available, global weather predictions became practical. By the mid 1970s, improvements in modeling, computing capability, and accuracy of the polar orbiter data led to the operational production of global atmospheric predictions. There followed a period of steady improvement in the accuracy and range of weather forecasts in the U.S. and in developed and some developing countries around the world that continues today. It is worth noting that data from polar orbiters have contributed enormously to the development of the global climate record over the last 30 years. For example, in the IPCC (2001) report, 29 likelihood statements were made regarding observed climate trends, and 17 were based on data from NOAA’s polar orbiting satellites.

By the mid-1980s, the skill of the three-day forecast was equivalent to that of the one-and a half day forecast 15 years earlier, and by 1990, skillful daily forecasts were being issued for five days in advance. Currently, the numerical forecast models provide skillful predictions out to seven or eight days, based largely on global observations provided by polar satellites. This progress depended on improvements in observing technology, advances in available supercomputers, research and development in understanding and modeling of the atmosphere, and in learning how to effectively use the observations from polar orbiting satellites.

The improvement in weather forecasting can be amply demonstrated by various, objective, statistical measures used by meteorologists. These measures are helpful to meteorologists, but are not very useful for laypersons. A more understandable, if less scientific, indicator is eavesdropping on conversations in the supermarket checkout lane. In the mid-1970s one would *never* hear ordinary citizens discussing their personal decisions based on a weather forecast beyond tomorrow, and rarely (and skeptically) on tomorrow’s forecast. But by the mid 1990s, such conversations were quite common. In January 1996, for example, I overheard a shopper on Monday basing her winter vacation plans for Friday on a five-day forecast of heavy snow. She had airline reservations on Friday for a trip to Cancun, but on the basis of that forecast, changed her reservations to Thursday. It proved to be a good decision.

At least as important, a significant number of institutions in weather- and climate-sensitive economic sectors in the mid-1980s began to realize that weather forecasts out to five days in advance had achieved sufficient accuracy that business decision making

processes could usefully factor them in, with due recognition of the predictions' inherent uncertainty. It is difficult to quantify this growth in the use of weather forecasts in business decisions, but it has led to a demonstrable and significant growth in the private weather information-provider industry. It is now estimated that between two and four trillion dollars of the U.S. economy is sensitive to weather and climate. A sound and continually improving prediction capability is essential to the efficiency of those weather and climate sensitive sectors.

Largely because of factors not related directly to weather and climate, we as a society are even more sensitive to weather and climate than was the case even ten years ago. For example:

- “Just-in-time” shipping. A Master of a container vessel that operates in and out of Baltimore harbor begins to make plans for docking when the ship is still two to three days out, in order to make sure that the delivery vehicles ... trucks and railroads ... will be available, for there is no warehouse: his vessel *is* the warehouse, and the longer it is unnecessarily at dock, the less revenue it generates for its owners. Thus the Master needs an accurate three-day forecast of wind, temperature, precipitation, and water level for Baltimore harbor.
- Energy deregulation. Prior to deregulation, electric utilities maintained excess generating capacity to be able to handle sharp, unexpected increases in demand, such as might be generated by an unexpected cold front passage in winter or a predicted sea breeze that failed to cool off a coastal city in summer. Now, it is uneconomical to maintain unused capacity; instead, a utility that has a need purchases energy from another utility, for fairly low prices if far enough in advance but at spectacular prices on short notice. Thus, an accurate forecast of temperature shifts several days in advance can make a very large financial difference.
- Commercial aviation. In the last ten years, three to seven day forecasts of major winter storms have permitted airlines to anticipate airport closures and move their aircraft out of the path of the storm, thus making recovery of normal operations after the storm more efficient.
- Highway and utility line maintenance. Skillful three to seven day forecasts allow local highway maintenance authorities and utility companies to plan their response to an incipient winter storm by pre-positioning crews, equipment, and materiel.

The instruments on NPOESS are technologically advanced compared to the current generation of polar orbiters. Perhaps one of the most important for three to seven day forecasts is the microwave sounder, data from which are relatively unaffected by clouds. Major international forecasting centers such as NOAA's NCEP have already begun to use observations from the research version of the new sounder that will be flown on NPOESS, and significant improvements in experimental forecasts have resulted. At NCEP, preparation for NPOESS depends crucially on the Joint Center for Satellite Data Assimilation, a joint activity of NOAA, NASA, DoD and NSF. Although under-funded in my view, the JCSDA houses research and development efforts essential to the effective use of NPOESS data.

The microwave sounders are also very important for climate monitoring and assessment. One of the questions currently being debated has to do with evidence that temperatures at the earth's surface, averaged over the globe, have been increasing, and many scientists attribute this in significant degree to the increase in atmospheric carbon dioxide due to fossil fuels. In the atmosphere above the earth's surface, however, temperatures have not changed in the same way, leading to considerable uncertainty in the scientific and policy debate over global warming. The microwave sounders on NPOESS will provide continuity in the record of upper air temperature structure essential to resolving the debate on the basis of sound evidence.

Thus, the prospect of a reduction in the availability of polar orbiter observations is dismaying; not so much from the standpoint of warnings of immediate weather hazards, but from the inevitable degradation of three to seven day forecasts and our ability to further extend them to ten days and beyond, as well as from the standpoint of the disruption of the climate record. The NPOESS orbiter that would be delayed is the first one that would carry the important microwave sounder mentioned above. The impact of an interruption in the availability of microwave data on the climate record would be severe and would greatly increase the uncertainty of the climate record at a time when decision makers are demanding that climate scientists decrease the uncertainty.

The quality of weather forecasts would not likely revert to that of 30 years ago, for major improvements have been made in other aspects of the forecast process. Nevertheless, I believe that there be a serious decline in the accuracy and reliability of forecasts over the U.S. The impact would be felt by the industries noted above that have learned to depend on accurate three to seven day forecasts: transportation, energy, agriculture, construction, recreation, etc. And this would be felt not only in the U.S. but also worldwide, as all of the weather forecast centers in the world depend on observations from polar orbiter satellites. All of these sectors would be less efficient, and in some cases much more vulnerable.

As a final note, NPOESS will not do everything that is needed, and additional technological advances will be necessary for further improvements in weather forecast accuracy, as well as for monitoring and assessing climate trends. For example, wind profiles over the world's oceans are badly needed, but cost-feasible technology is not yet available. When such technology becomes available, though, it will undoubtedly be deployed on polar orbiting satellites. Thank you very much for the opportunity to participate in this hearing and to comment on this very important issue.

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Ronald D. McPherson became the Executive Director of the American Meteorological Society (AMS) January, 1999. The AMS is a nonprofit scientific and professional organization with a membership of over 11,000, representing the university, governmental and private sectors of the atmospheric, oceanographic and related sciences.

Prior to that he served for nearly 40 years with the National Weather Service, ending his career with eight years as the Director of the National Centers for Environmental Prediction (NCEP). His responsibilities there included overall management of the nine centers comprising NCEP, including scientific and technical leadership, budget issues, personnel and policy.

Earlier, Dr. McPherson served as Deputy Director for the National Weather Service. The National Weather Service is responsible for providing weather and flood warnings and forecasts for the United States and its coastal and offshore waters. The Weather Service employs approximately 5,000 people in more than 300 locations throughout the United States and its territories.

Dr. McPherson has been extensively published in scientific journals including *Journal of Applied Meteorology*, *Monthly Weather Review* and *Bulletin of American Meteorological Society*.

He earned the Department of Commerce Silver Medal and the Presidential Rank Award as an outstanding executive. He was elected Fellow of the AMS in 1981.

Dr. McPherson holds a Bachelors degree in Meteorology, a Masters degree in Environmental Engineering and a Ph.D. in Atmospheric Sciences from the University of Texas at Austin.

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The American Meteorological Society is the nation's leading professional society for scientists in the atmospheric and related sciences. Founded in 1919, the Society promotes the development and dissemination of information on atmospheric, oceanic, and hydrologic sciences. The Society publishes nine well-respected scientific journals, sponsors scientific conferences and policy discussions, and supports public education programs across the country. Additional information on the AMS is available on the Internet at <http://www.ametsoc.org/ams>.